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Equilibrium isotherms, kinetics, and thermodynamics studies of methylene blue adsorption on pomegranate (*Punica granatum*) peels as a natural low-cost biosorbent

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ABSTRACT

In this work, the potential of biomass waste, pomegranate (*Punica granatum*) peel (PP) as low cost adsorbent for adsorption of methylene blue (MB) from aqueous solution was studied. The physicochemical properties of PP were characterized using instrumental analyses such as CHNS-O analyzer, Brunauer-Emmett-Teller (BET), Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), and point of zero charge (pH_{pzc}) analysis. Batch mode adsorption studies were conducted by varying operational parameters such as adsorbent dosage (0.02–0.16 g), solution pH 3–11, initial MB concentrations (50–300 mg/L), and contact time (0–390 min). The equilibrium data was found to better fit with Langmuir isotherm model compare to Freundlich model. The maximum adsorption capacity, q_{max} of PP for MB was 200 mg/g at 303 K. The kinetic study revealed that the present system obeyed pseudo-second-order (PSO) model. The thermodynamic adsorption parameters, standard enthalpy ($\Delta H°$), standard entropy ($\Delta S°$), and standard free energy ($\Delta G°$) showed that the adsorption of MB onto PP surface exothermic and spontaneous under the experimented conditions. All results mentioned above indicate that the PP can feasibly employ for the elimination of MB from aqueous solution.

Keywords: Adsorption; Methylene blue; Pomegranate peels; Biomass waste; Low-cost adsorbent

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